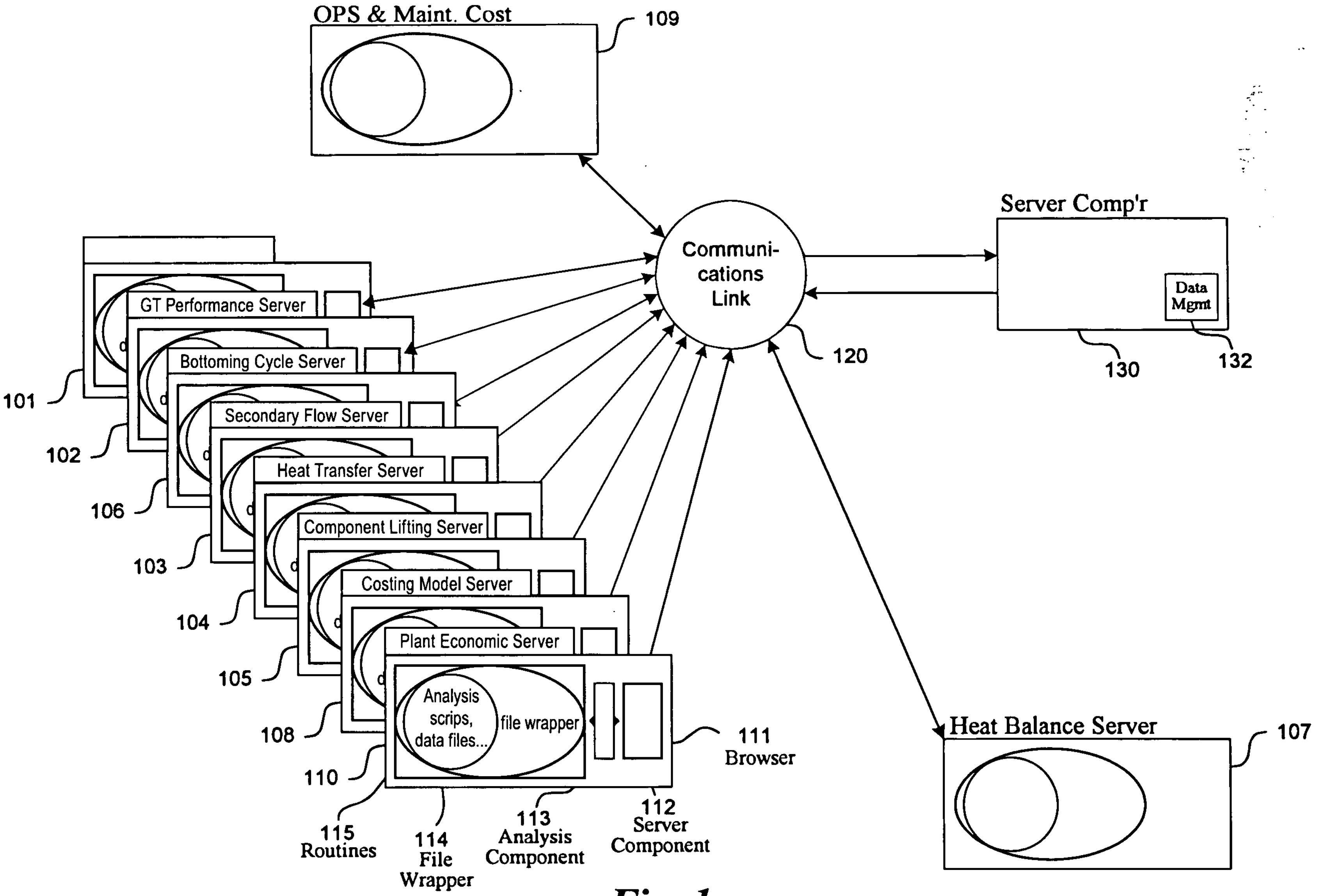

OPS & Maint. Cost
109
Server Comp'r
Data Mgmt
130
132
Communi-cations Link
120
GT Performance Server
Bottoming Cycle Server
Secondary Flow Server
Heat Transfer Server
Component Lifting Server
Costing Model Server
Plant Economic Server
Analysis scrips, data files...
file wrapper
101
102
106
103
104
105
108
110
111 Browser
115 Routines
114 File Wrapper
113 Analysis Component
112 Server Component
Heat Balance Server
107

Fig. 1

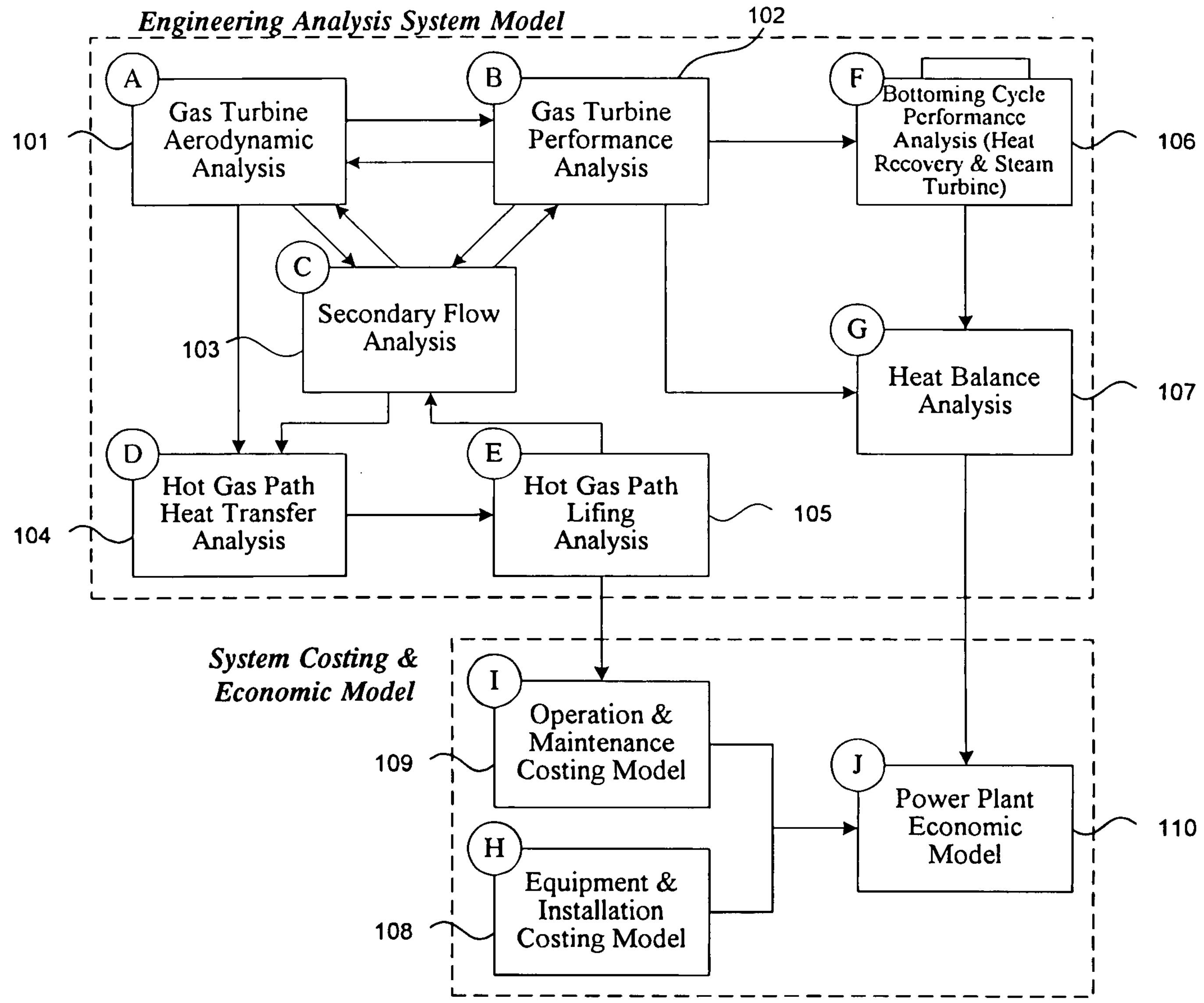

Engineering Analysis System Model
102
A
Gas Turbine Aerodynamic Analysis
101
B
Gas Turbine Performance Analysis
F
Bottoming Cycle Performance Analysis (Heat Recovery & Steam Turbine)
106
C
Secondary Flow Analysis
103
G
Heat Balance Analysis
107
D
Hot Gas Path Heat Transfer Analysis
104
E
Hot Gas Path Lifing Analysis
105
System Costing & Economic Model
I
Operation & Maintenance Costing Model
109
J
Power Plant Economic Model
110
H
Equipment & Installation Costing Model
108

Fig. 2

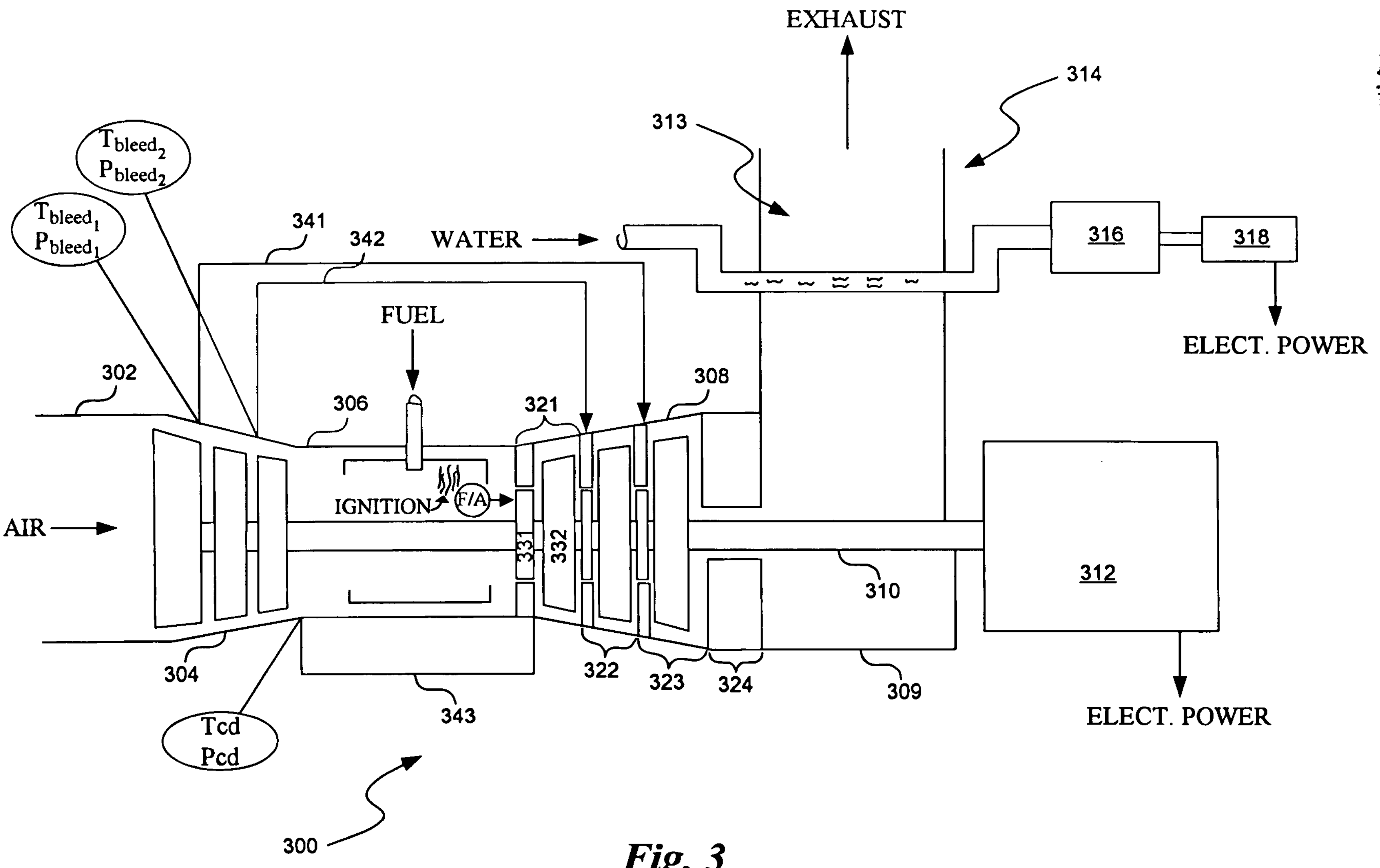

EXHAUST
314
313
WATER
316
318
ELECT. POWER
341
342
T_{bleed_2} P_{bleed_2}
T_{bleed_1} P_{bleed_1}
FUEL
302
306
321
308
AIR
IGNITION
F/A
331
332
310
312
304
322
323
324
309
343
Tcd Pcd
ELECT. POWER
300

Fig. 3

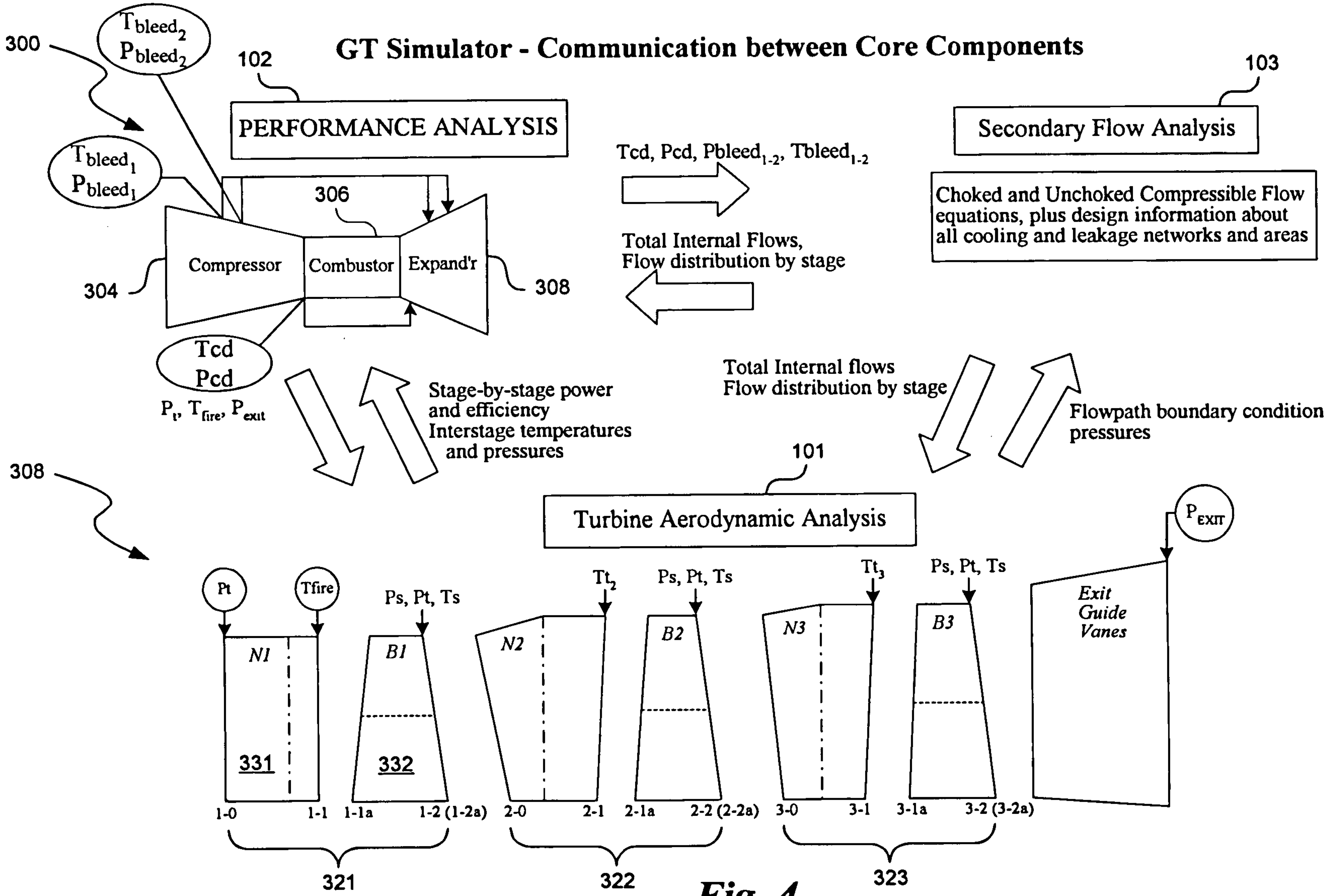

GT Simulator - Communication between Core Components
300
T_{bleed_2} P_{bleed_2}
T_{bleed_1} P_{bleed_1}
102
PERFORMANCE ANALYSIS
306
Compressor
Combustor
Expand'r
304
308
Tcd Pcd
P_t, T_{fire}, P_{exit}
Tcd, Pcd, $Pbleed_{1-2}$, $Tbleed_{1-2}$
Total Internal Flows, Flow distribution by stage
103
Secondary Flow Analysis
Choked and Unchoked Compressible Flow equations, plus design information about all cooling and leakage networks and areas
Stage-by-stage power and efficiency Interstage temperatures and pressures
Total Internal flows Flow distribution by stage
Flowpath boundary condition pressures
101
Turbine Aerodynamic Analysis
308
Pt
Tfire
N1
331
B1
332
Ps, Pt, Ts
Tt_2
N2
B2
Ps, Pt, Ts
Tt_3
N3
B3
Ps, Pt, Ts
P_{EXIT}
Exit Guide Vanes
1-0
1-1
1-1a
1-2 (1-2a)
2-0
2-1
2-1a
2-2 (2-2a)
3-0
3-1
3-1a
3-2 (3-2a)
321
322
323

Fig. 4

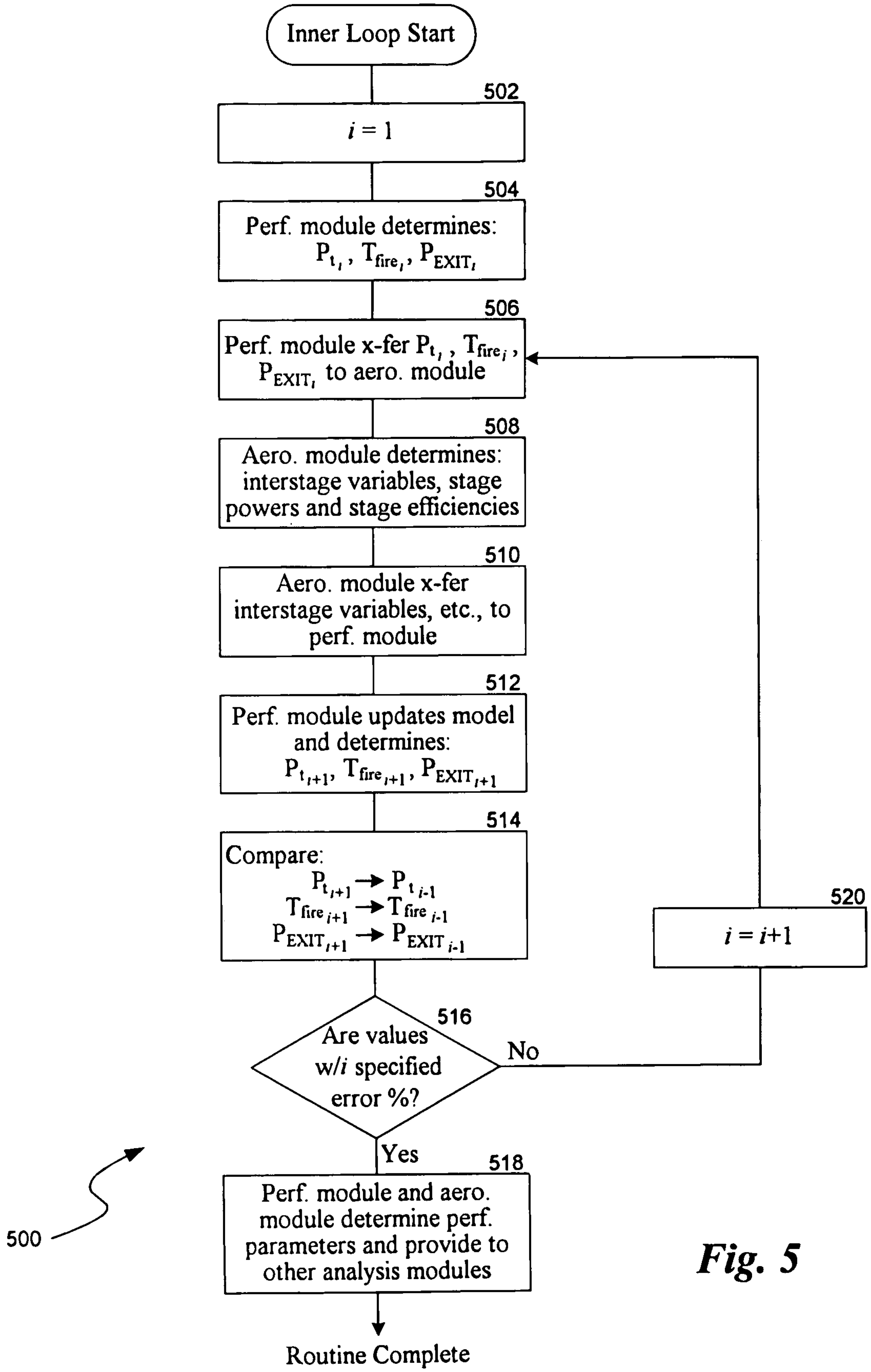

Inner Loop Start
502
$i = 1$
504
Perf. module determines: P_{t_i}, T_{fire_i}, P_{EXIT_i}
506
Perf. module x-fer P_{t_i}, T_{fire_i}, P_{EXIT_i} to aero. module
508
Aero. module determines: interstage variables, stage powers and stage efficiencies
510
Aero. module x-fer interstage variables, etc., to perf. module
512
Perf. module updates model and determines: $P_{t_{i+1}}$, $T_{fire_{i+1}}$, $P_{EXIT_{i+1}}$
514
Compare:
$P_{t_{i+1}} \rightarrow P_{t_{i-1}}$
$T_{fire_{i+1}} \rightarrow T_{fire_{i-1}}$
$P_{EXIT_{i+1}} \rightarrow P_{EXIT_{i-1}}$
516
Are values w/i specified error %?
No
520
$i = i+1$
Yes
518
Perf. module and aero. module determine perf. parameters and provide to other analysis modules
Routine Complete
500

Fig. 5

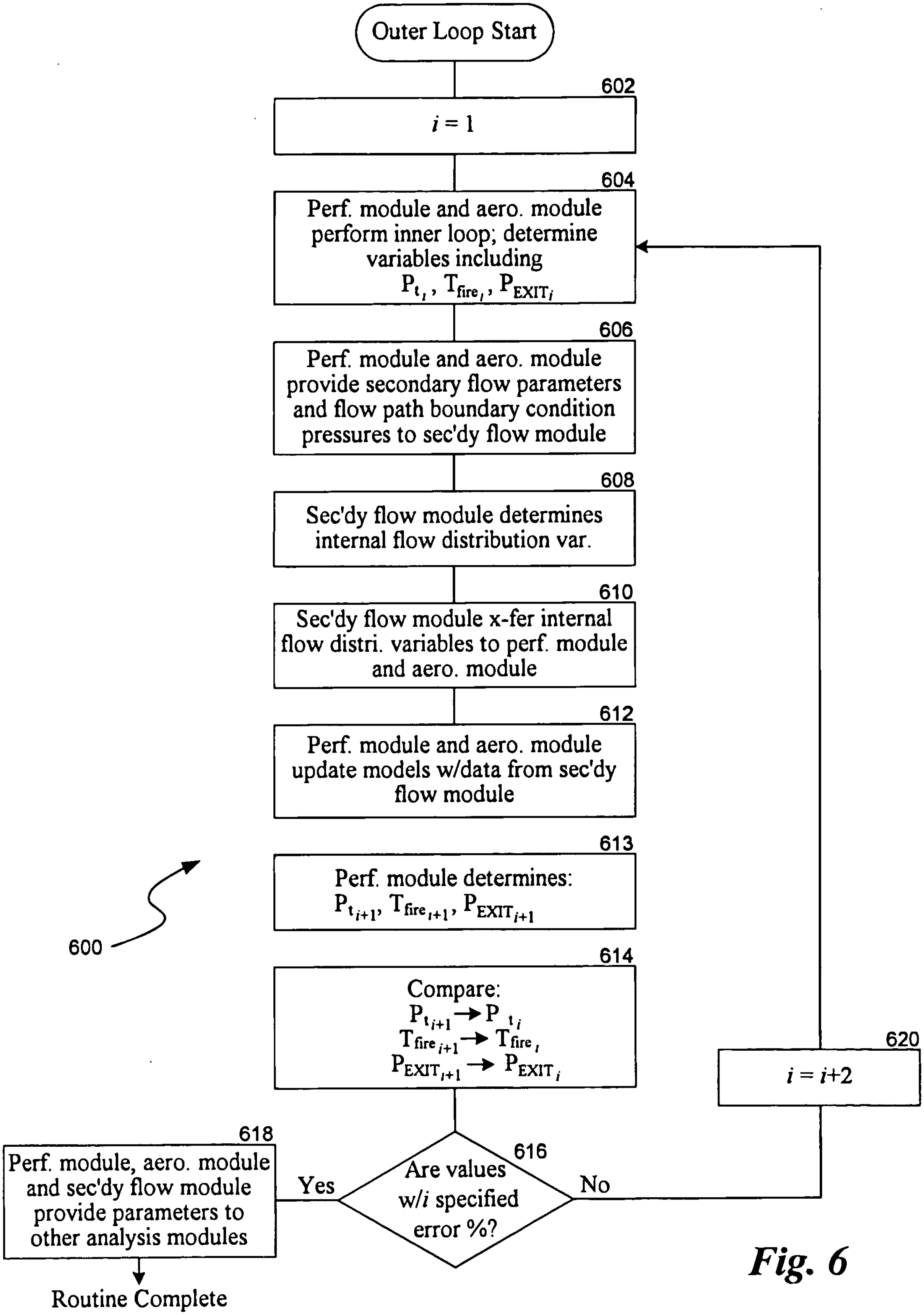
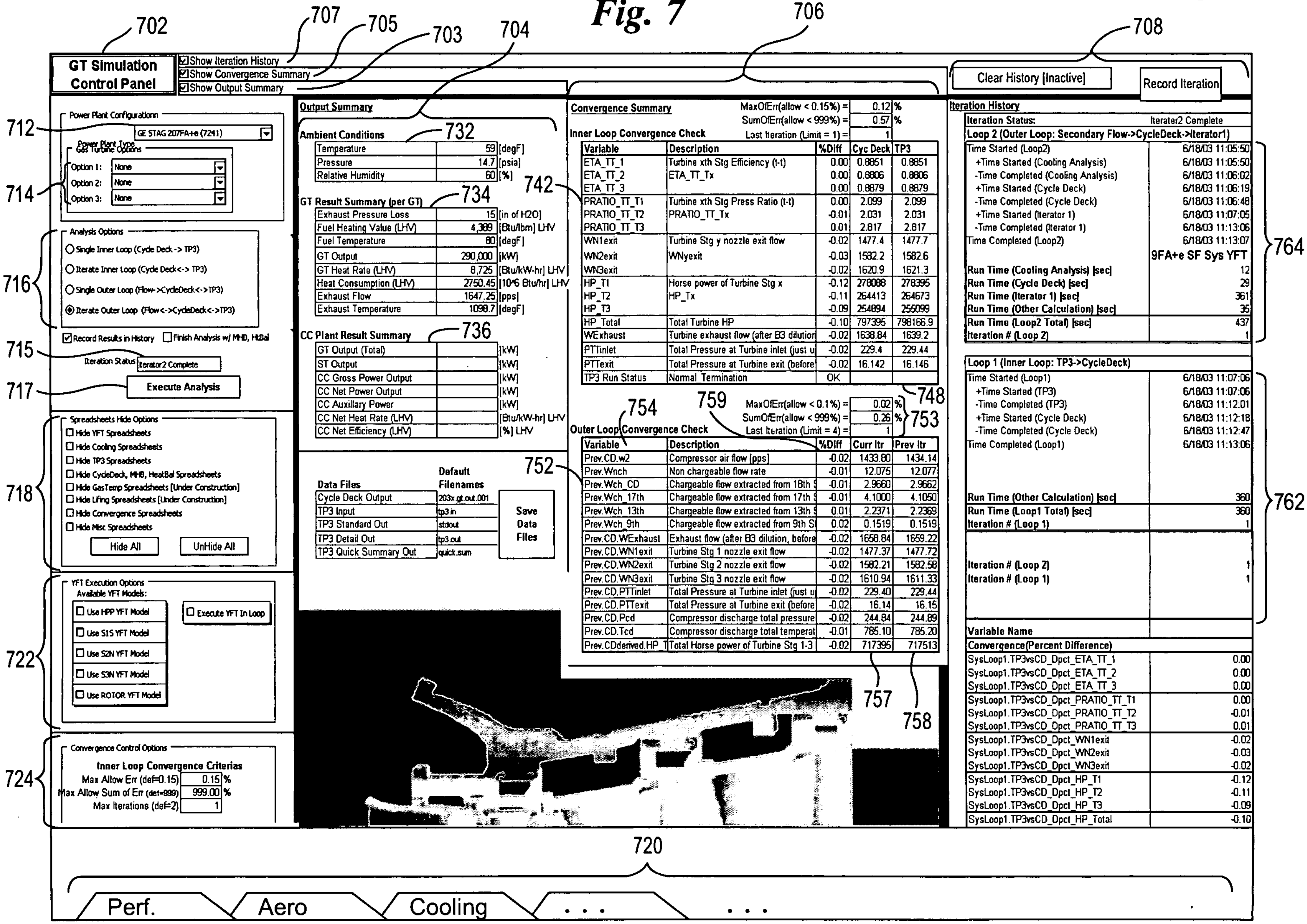

Outer Loop Start
602
$i = 1$
604
Perf. module and aero. module perform inner loop; determine variables including P_{t_i}, T_{fire_i}, P_{EXIT_i}
606
Perf. module and aero. module provide secondary flow parameters and flow path boundary condition pressures to sec'dy flow module
608
Sec'dy flow module determines internal flow distribution var.
610
Sec'dy flow module x-fer internal flow distri. variables to perf. module and aero. module
612
Perf. module and aero. module update models w/data from sec'dy flow module
613
Perf. module determines: $P_{t_{i+1}}$, $T_{fire_{i+1}}$, $P_{EXIT_{i+1}}$
600
614
Compare: $P_{t_{i+1}} \rightarrow P_{t_i}$ $T_{fire_{i+1}} \rightarrow T_{fire_i}$ $P_{EXIT_{i+1}} \rightarrow P_{EXIT_i}$
620
$i = i+2$
618
Perf. module, aero. module and sec'dy flow module provide parameters to other analysis modules
Yes
616
Are values w/i specified error %?
No
Routine Complete

Fig. 6

Fig. 7



☑ Show Iteration History
☑ Show Convergence Summary
☑ Show Output Summary

Power Plant Configurationn: GE STAG 207FA+e (7241)

Power Plant Type / Gas Turbine Options
Option 1: None
Option 2: None
Option 3: None

Analysis Options
○ Single Inner Loop (Cycle Deck -> TP3)
○ Iterate Inner Loop (Cycle Deck<-> TP3)
○ Single Outer Loop (Flow->CycleDeck<->TP3)
● Iterate Outer Loop (Flow<->CycleDeck<->TP3)

☑ Record Results in History ☐ Finish Analysis w/ MHB, HtBal

Iteration Status: Iterator2 Complete

Spreadsheets Hide Options
☐ Hide YFT Spreadsheets
☐ Hide Cooling Spreadsheets
☐ Hide TP3 Spreadsheets
☐ Hide CycleDeck, MHB, HeatBal Spreadsheets
☐ Hide GasTemp Spreadsheets [Under Construction]
☐ Hide Lifing Spreadsheets [Under Construction]
☐ Hide Convergence Spreadsheets
☐ Hide Misc Spreadsheets

YFT Execution Options
Available YFT Models:
☐ Use HPP YFT Model
☐ Use S1S YFT Model
☐ Use S2N YFT Model
☐ Use S3N YFT Model
☐ Use ROTOR YFT Model
☐ Execute YFT In Loop

Convergence Control Options
Inner Loop Convergence Criterias
Max Allow Err (def=0.15) 0.15 %
Max Allow Sum of Err (def=999) 999.00 %
Max Iterations (def=2) 1

Output Summary

Ambient Conditions

Temperature	59	[degF]
Pressure	14.7	[psia]
Relative Humidity	60	[%]

GT Result Summary (per GT)

Exhaust Pressure Loss	15	[in of H2O]
Fuel Heating Value (LHV)	4,389	[Btu/lbm] LHV
Fuel Temperature	80	[degF]
GT Output	290,000	[kW]
GT Heat Rate (LHV)	8,725	[Btu/kW-hr] LHV
Heat Consumption (LHV)	2750.45	[10^6 Btu/hr] LHV
Exhaust Flow	1647.25	[pps]
Exhaust Temperature	1098.7	[degF]

CC Plant Result Summary

GT Output (Total)		[kW]
ST Output		[kW]
CC Gross Power Output		[kW]
CC Net Power Output		[kW]
CC Auxillary Power		[kW]
CC Net Heat Rate (LHV)		[Btu/kW-hr] LHV
CC Net Efficiency (LHV)		[%] LHV

Data Files	Default Filenames
Cycle Deck Output	203x.gt.out.001
TP3 Input	tp3.in
TP3 Standard Out	stdout
TP3 Detail Out	tp3.out
TP3 Quick Summary Out	quick.sum

Convergence Summary

MaxOfErr(allow < 0.15%) = 0.12 %
SumOfErr(allow < 999%) = 0.57 %
Last Iteration (Limit = 1) = 1

Inner Loop Convergence Check

Variable	Description	%Diff	Cyc Deck	TP3
ETA_TT_1	Turbine xth Stg Efficiency (t-t)	0.00	0.8851	0.8851
ETA_TT_2	ETA_TT_Tx	0.00	0.8806	0.8806
ETA_TT_3		0.00	0.8879	0.8879
PRATIO_TT_T1	Turbine xth Stg Press Ratio (t-t)	0.00	2.099	2.099
PRATIO_TT_T2	PRATIO_TT_Tx	-0.01	2.031	2.031
PRATIO_TT_T3		0.01	2.817	2.817
WN1exit	Turbine Stg y nozzle exit flow	-0.02	1477.4	1477.7
WN2exit	WNyexit	-0.03	1582.2	1582.6
WN3exit		-0.02	1620.9	1621.3
HP_T1	Horse power of Turbine Stg x	-0.12	278088	278395
HP_T2	HP_Tx	-0.11	264413	264673
HP_T3		-0.09	254894	255099
HP_Total	Total Turbine HP	-0.10	797395	798166.9
WExhaust	Turbine exhaust flow (after B3 dilution	-0.02	1638.84	1639.2
PTTinlet	Total Pressure at Turbine inlet (just u	-0.02	229.4	229.44
PTTexit	Total Pressure at Turbine exit (before	-0.02	16.142	16.146
TP3 Run Status	Normal_Termination	OK		

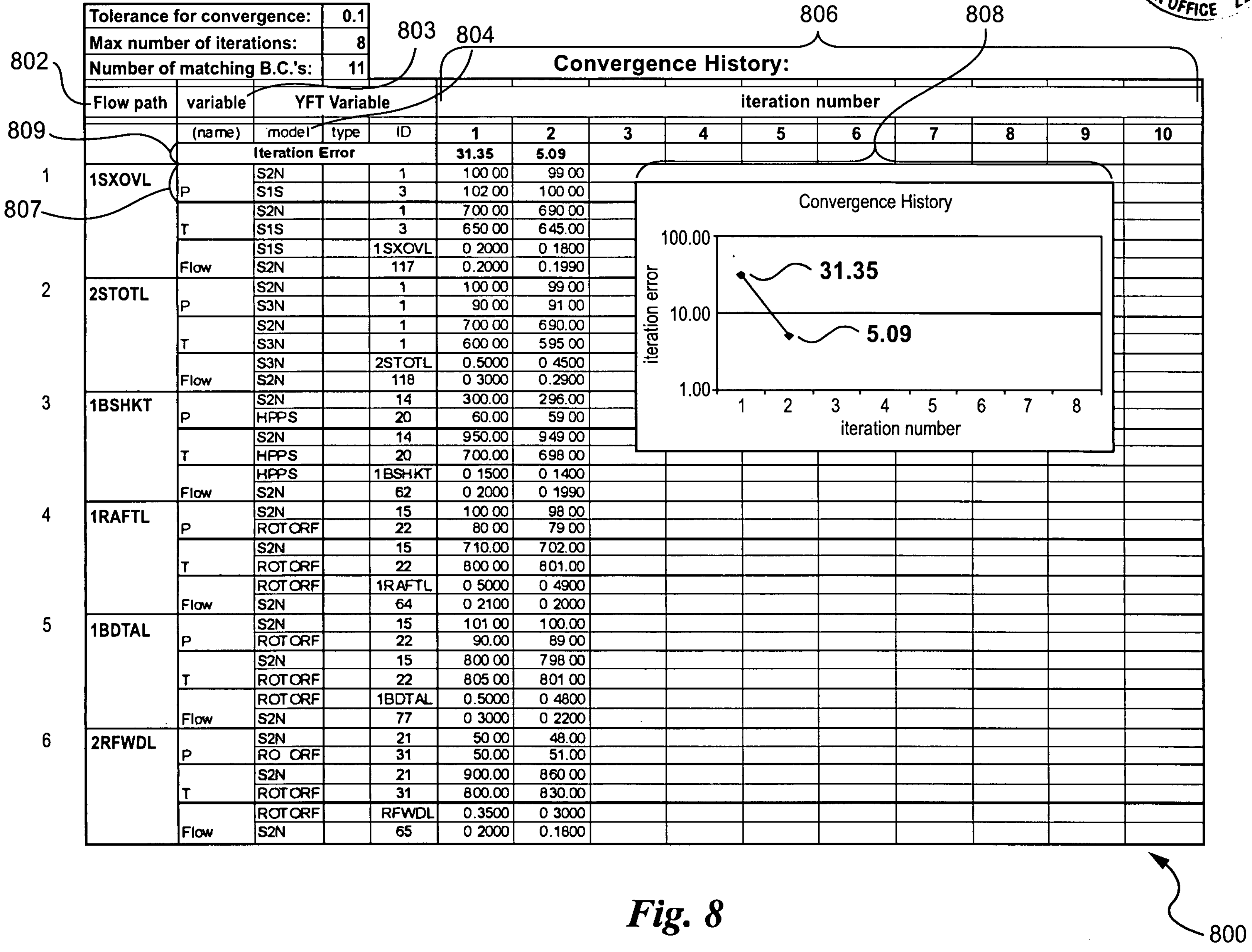
MaxOfErr(allow < 0.1%) = 0.02 %
SumOfErr(allow < 999%) = 0.26 %
Last Iteration (Limit = 4) = 1

Outer Loop Convergence Check

Variable	Description	%Diff	Curr Itr	Prev Itr
Prev.CD.w2	Compressor air flow [pps]	-0.02	1433.80	1434.14
Prev.Wnch	Non chargeable flow rate	-0.01	12.075	12.077
Prev.Wch_CD	Chargeable flow extracted from 18th S	-0.01	2.9660	2.9662
Prev.Wch_17th	Chargeable flow extracted from 17th S	-0.01	4.1000	4.1050
Prev.Wch_13th	Chargeable flow extracted from 13th S	0.01	2.2371	2.2369
Prev.Wch_9th	Chargeable flow extracted from 9th St	0.02	0.1519	0.1519
Prev.CD.WExhaust	Exhaust flow (after B3 dilution, before	-0.02	1658.84	1659.22
Prev.CD.WN1exit	Turbine Stg 1 nozzle exit flow	-0.02	1477.37	1477.72
Prev.CD.WN2exit	Turbine Stg 2 nozzle exit flow	-0.02	1582.21	1582.58
Prev.CD.WN3exit	Turbine Stg 3 nozzle exit flow	-0.02	1610.94	1611.33
Prev.CD.PTTinlet	Total Pressure at Turbine inlet (just u	-0.02	229.40	229.44
Prev.CD.PTTexit	Total Pressure at Turbine exit (before	-0.02	16.14	16.15
Prev.CD.Pcd	Compressor discharge total pressure	-0.02	244.84	244.89
Prev.CD.Tcd	Compressor discharge total temperat	-0.01	785.10	785.20
Prev.CDderived.HP_T	Total Horse power of Turbine Stg 1-3	-0.02	717395	717513

Iteration History

Iteration Status:	Iterater2 Complete
Loop 2 (Outer Loop: Secondary Flow->CycleDeck->Iterator1)	
Time Started (Loop2)	6/18/03 11:05:50
+Time Started (Cooling Analysis)	6/18/03 11:05:50
-Time Completed (Cooling Analysis)	6/18/03 11:06:02
+Time Started (Cycle Deck)	6/18/03 11:06:19
-Time Completed (Cycle Deck)	6/18/03 11:06:48
+Time Started (Iterator 1)	6/18/03 11:07:05
-Time Completed (Iterator 1)	6/18/03 11:13:06
Time Completed (Loop2)	6/18/03 11:13:07
	9FA+e SF Sys YFT
Run Time (Cooling Analysis) [sec]	12
Run Time (Cycle Deck) [sec]	29
Run Time (Iterator 1) [sec]	361
Run Time (Other Calculation) [sec]	35
Run Time (Loop2 Total) [sec]	437
Iteration # (Loop 2)	1
Loop 1 (Inner Loop: TP3->CycleDeck)	
Time Started (Loop1)	6/18/03 11:07:06
+Time Started (TP3)	6/18/03 11:07:06
-Time Completed (TP3)	6/18/03 11:12:01
+Time Started (Cycle Deck)	6/18/03 11:12:18
-Time Completed (Cycle Deck)	6/18/03 11:12:47
Time Completed (Loop1)	6/18/03 11:13:06
Run Time (Other Calculation) [sec]	360
Run Time (Loop1 Total) [sec]	360
Iteration # (Loop 1)	1
Iteration # (Loop 2)	1
Iteration # (Loop 1)	1
Variable Name	
Convergence(Percent Difference)	
SysLoop1.TP3vsCD_Dpct_ETA_TT_1	0.00
SysLoop1.TP3vsCD_Dpct_ETA_TT_2	0.00
SysLoop1.TP3vsCD_Dpct_ETA_TT_3	0.00
SysLoop1.TP3vsCD_Dpct_PRATIO_TT_T1	0.00
SysLoop1.TP3vsCD_Dpct_PRATIO_TT_T2	-0.01
SysLoop1.TP3vsCD_Dpct_PRATIO_TT_T3	0.01
SysLoop1.TP3vsCD_Dpct_WN1exit	-0.02
SysLoop1.TP3vsCD_Dpct_WN2exit	-0.03
SysLoop1.TP3vsCD_Dpct_WN3exit	-0.02
SysLoop1.TP3vsCD_Dpct_HP_T1	-0.12
SysLoop1.TP3vsCD_Dpct_HP_T2	-0.11
SysLoop1.TP3vsCD_Dpct_HP_T3	-0.09
SysLoop1.TP3vsCD_Dpct_HP_Total	-0.10

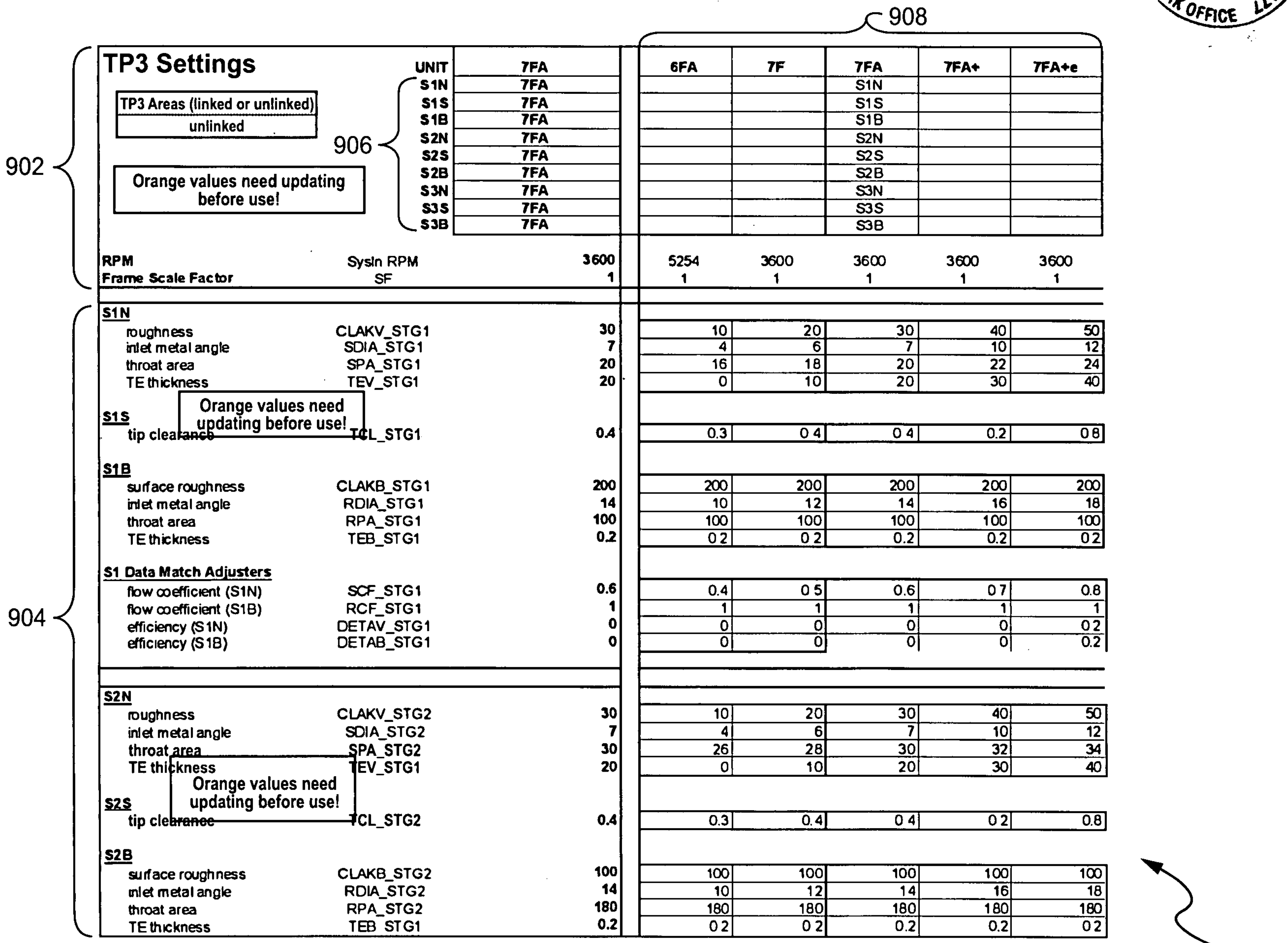


Tolerance for convergence:	0.1
Max number of iterations:	8
Number of matching B.C.'s:	11

Convergence History:

	Flow path	variable	YFT Variable			iteration number									
		(name)	model	type	ID	1	2	3	4	5	6	7	8	9	10
		Iteration Error				31.35	5.09								
1	1SXOVL	P	S2N		1	100.00	99.00								
			S1S		3	102.00	100.00								
		T	S2N		1	700.00	690.00								
			S1S		3	650.00	645.00								
		Flow	S1S		1SXOVL	0.2000	0.1800								
			S2N		117	0.2000	0.1990								
2	2STOTL	P	S2N		1	100.00	99.00								
			S3N		1	90.00	91.00								
		T	S2N		1	700.00	690.00								
			S3N		1	600.00	595.00								
		Flow	S3N		2STOTL	0.5000	0.4500								
			S2N		118	0.3000	0.2900								
3	1BSHKT	P	S2N		14	300.00	296.00								
			HPPS		20	60.00	59.00								
		T	S2N		14	950.00	949.00								
			HPPS		20	700.00	698.00								
		Flow	HPPS		1BSHKT	0.1500	0.1400								
			S2N		62	0.2000	0.1990								
4	1RAFTL	P	S2N		15	100.00	98.00								
			ROTORF		22	80.00	79.00								
		T	S2N		15	710.00	702.00								
			ROTORF		22	800.00	801.00								
		Flow	ROTORF		1RAFTL	0.5000	0.4900								
			S2N		64	0.2100	0.2000								
5	1BDTAL	P	S2N		15	101.00	100.00								
			ROTORF		22	90.00	89.00								
		T	S2N		15	800.00	798.00								
			ROTORF		22	805.00	801.00								
		Flow	ROTORF		1BDTAL	0.5000	0.4800								
			S2N		77	0.3000	0.2200								
6	2RFWDL	P	S2N		21	50.00	48.00								
			RO ORF		31	50.00	51.00								
		T	S2N		21	900.00	860.00								
			ROTORF		31	800.00	830.00								
		Flow	ROTORF		RFWDL	0.3500	0.3000								
			S2N		65	0.2000	0.1800								

Fig. 8



TP3 Settings

TP3 Areas (linked or unlinked)
unlinked

Orange values need updating before use!

			6FA	7F	7FA	7FA+	7FA+e
UNIT		7FA					
S1N		7FA			S1N		
S1S		7FA			S1S		
S1B		7FA			S1B		
S2N		7FA			S2N		
S2S		7FA			S2S		
S2B		7FA			S2B		
S3N		7FA			S3N		
S3S		7FA			S3S		
S3B		7FA			S3B		
RPM	Sysln RPM	3600	5254	3600	3600	3600	3600
Frame Scale Factor	SF	1	1	1	1	1	1
S1N							
roughness	CLAKV_STG1	30	10	20	30	40	50
inlet metal angle	SDIA_STG1	7	4	6	7	10	12
throat area	SPA_STG1	20	16	18	20	22	24
TE thickness	TEV_STG1	20	0	10	20	30	40
S1S							
tip clearance	TCL_STG1	0.4	0.3	0.4	0.4	0.2	0.8
S1B							
surface roughness	CLAKB_STG1	200	200	200	200	200	200
inlet metal angle	RDIA_STG1	14	10	12	14	16	18
throat area	RPA_STG1	100	100	100	100	100	100
TE thickness	TEB_STG1	0.2	0.2	0.2	0.2	0.2	0.2
S1 Data Match Adjusters							
flow coefficient (S1N)	SCF_STG1	0.6	0.4	0.5	0.6	0.7	0.8
flow coefficient (S1B)	RCF_STG1	1	1	1	1	1	1
efficiency (S1N)	DETAV_STG1	0	0	0	0	0	0.2
efficiency (S1B)	DETAB_STG1	0	0	0	0	0	0.2
S2N							
roughness	CLAKV_STG2	30	10	20	30	40	50
inlet metal angle	SDIA_STG2	7	4	6	7	10	12
throat area	SPA_STG2	30	26	28	30	32	34
TE thickness	TEV_STG1	20	0	10	20	30	40
S2S							
tip clearance	TCL_STG2	0.4	0.3	0.4	0.4	0.2	0.8
S2B							
surface roughness	CLAKB_STG2	100	100	100	100	100	100
inlet metal angle	RDIA_STG2	14	10	12	14	16	18
throat area	RPA_STG2	180	180	180	180	180	180
TE thickness	TEB_STG1	0.2	0.2	0.2	0.2	0.2	0.2

Orange values need updating before use!

Orange values need updating before use!

Fig. 9